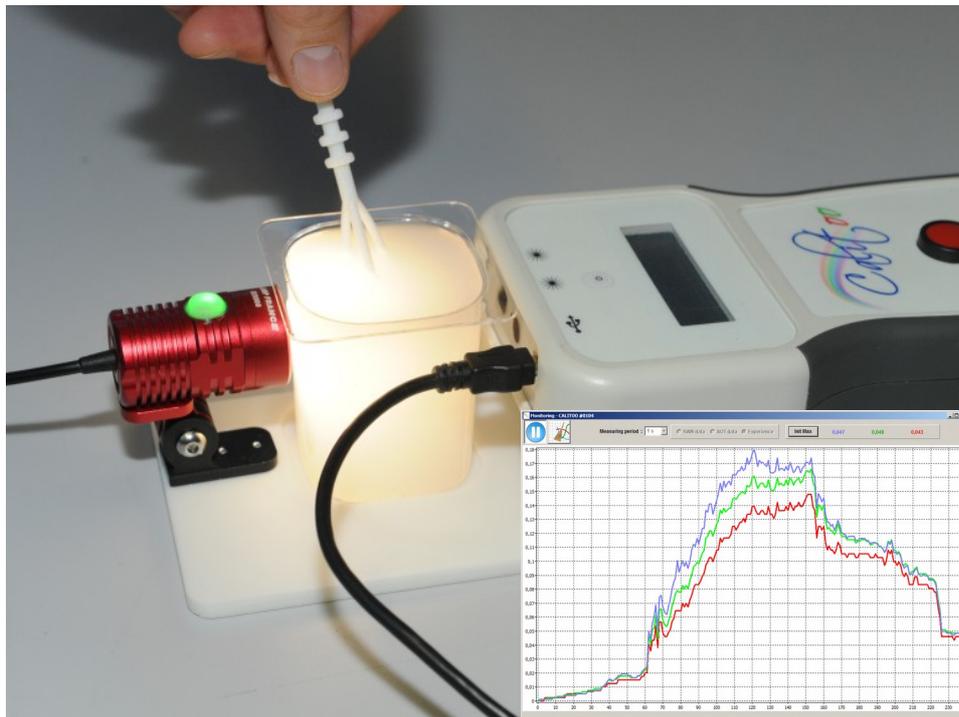


CALITOO

Sun photometer



Particles size detection



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Introduction

This document presents the contents of the teaching kit designed to understand by experiment, the technique of detecting the size of the aerosols particles.

This kit was inspired by an experiment realized by Luc Blarel from LOA⁽¹⁾.

The measurements are made with the same solar photometer Calitoo⁽²⁾ which makes it possible to make to study the aerosols.

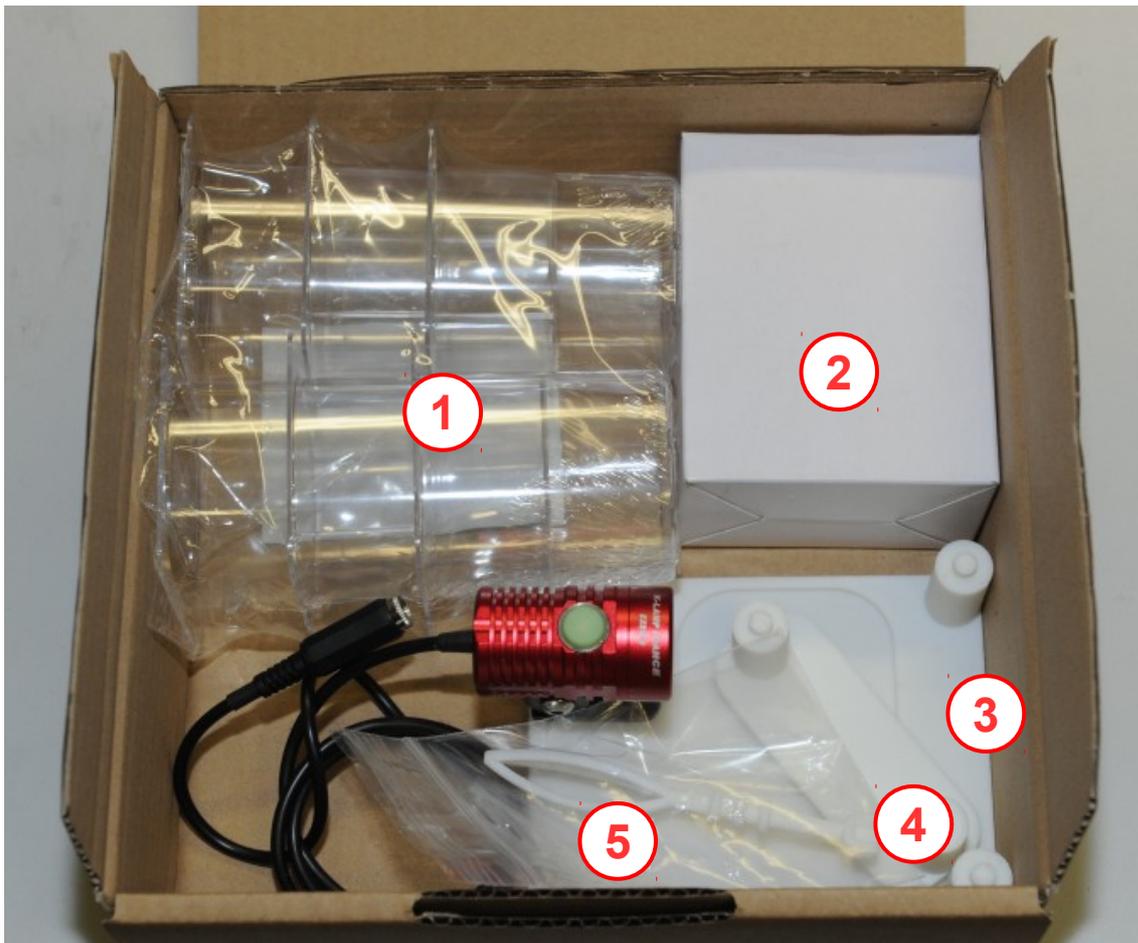
The simulation method makes it possible to carry out the measurements whatever the atmospheric conditions since the source of light is artificial here.

As designed, the kit leaves the imagination free.

Good experiments !
Calitoo Team at Tenum⁽³⁾

1. Kit contents

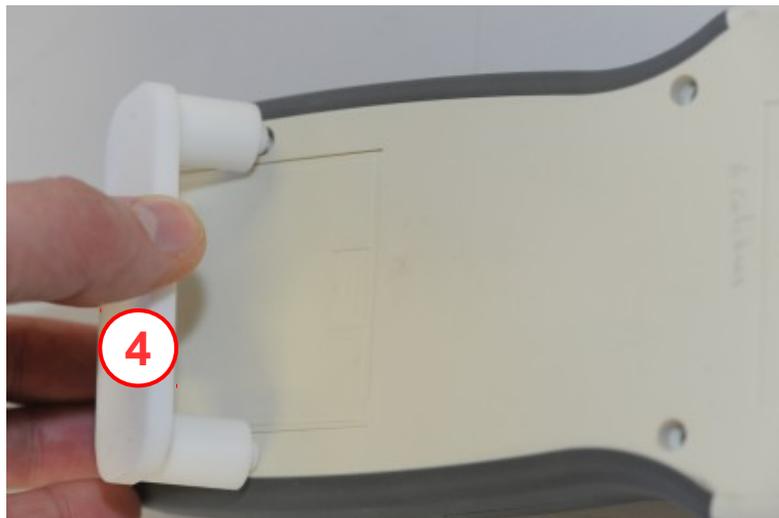
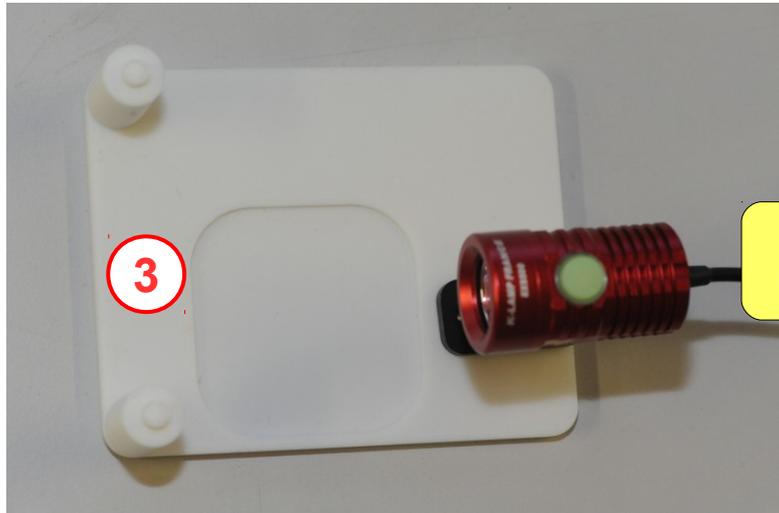
All kit elements are contained in a cardboard box of the following dimensions: 210 x 210 x80 mm.



1. 6 transparent plastic glasses to contain the water.
2. Wall outlet transformer to power the lamp (7.5V @ 1.6A).
3. Base with lamp and front mount for Calitoo.
4. Calitoo rear bracket.
5. Tool for dosing clay and milk.

2. Elements mounting

Mounting consists of placing the lugs in the mounting holes at the front of the Calitoo, on the base (**3**) and at the rear (**4**). No need for a tool to do the assembly.



3. Preparation for experiments

Principle

The principle is to simulate the Sun with the lamp and the atmosphere with the water placed in the transparent plastic glass. Pure water represents a pure atmosphere. We will place different elements in this water to simulate the particles present in the atmosphere.

Hardware preparation

You will need :

1 kit Calitoo Particles Sizer.

1 Calitoo photometer and his USB cable.

1 Computer on which the latest Calitoo software is installed (the one you usually use to download and process measurements from your photometer). Take advantage of this to install the latest version⁽²⁾.

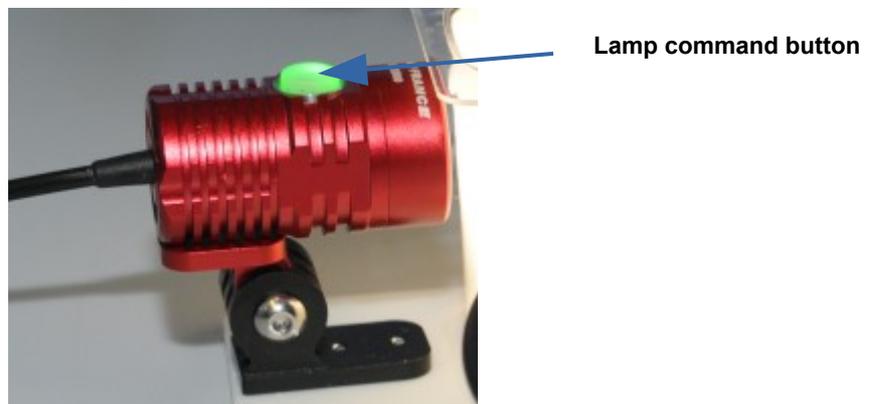
1 power supply (100 to 240 V ~ 60/50Hz) 2 pole EURO plug

Install the kit and the photometer (see §2).

Pour clear water into the plastic glass and place it between the lamp and the photometer.

Lamp Operation Mode

The lamp has 4 intensity levels that are selected by pressing the upper button.



1. Connect the lamp to power supply. The button above the lamp should light green. The lamp is off.
2. Press the button four times to obtain the maximum intensity of the lamp.

Be careful

After several minutes, the lamp heats up and therefore to preserve its lifetime, the luminous intensity decreases automatically. We advise you to turn it off, to cool it between each series of measurements.

The experiments described in this manual were carried out in the maximum power mode of the lamp.

To turn off the lamp without unplugging it, press the button during 4 seconds.

4. Conduct of experiments

Calibration of reference level

Pure water is poured into the glass. The Calitoo is connected to the computer via USB and turned on.

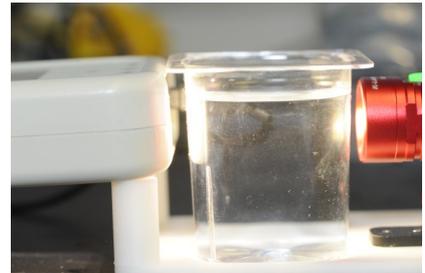
Start the PC and start the Calitoo software. The photometer must be recognized.

In the menu *Tools*, choose *Monitoring* :



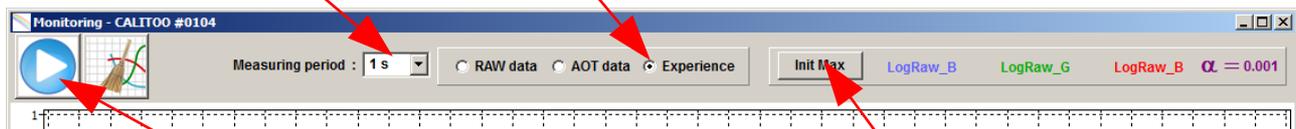
The Monitoring window is displayed.

Turn on the lamp and follow these instructions :



(1) Select period : 0,2s

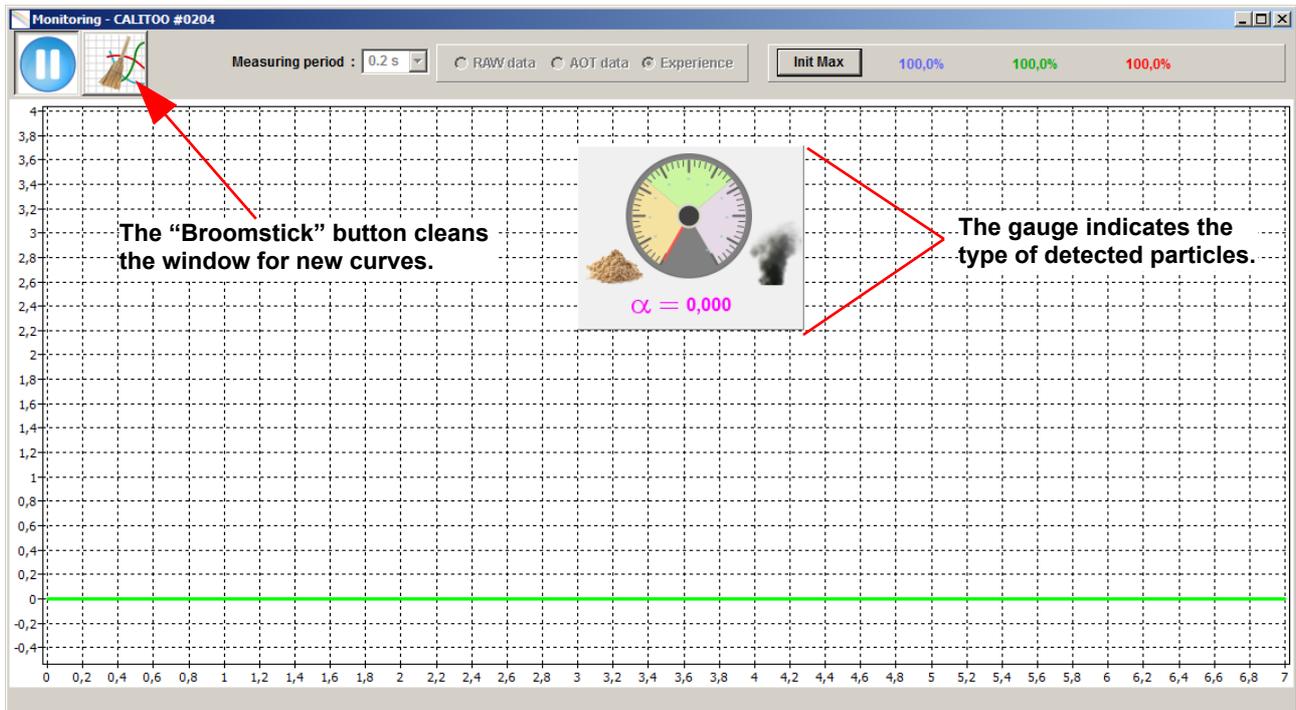
(2) Select : « Experience »



(3) Start measurements by clicking on Play icon button

(4) Calibrate levels by clicking on "Init Max" button

On this window, the calibration of reference levels is done. All curves are under the green line :



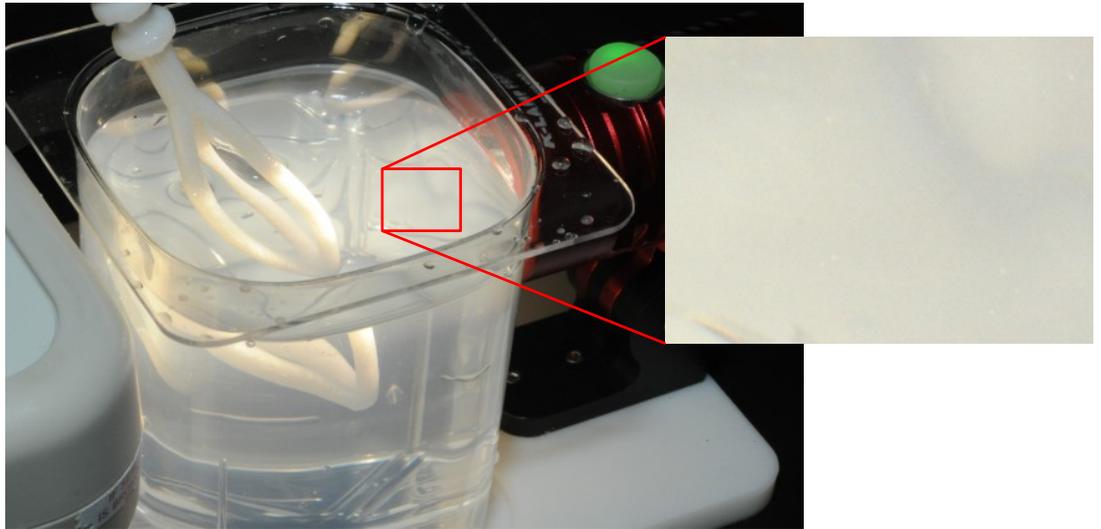
The gauge can be moved on the window with the mouse (left click pressed while moving).

Each time you start a new experiment, you must calibrate the reference level with pure water.

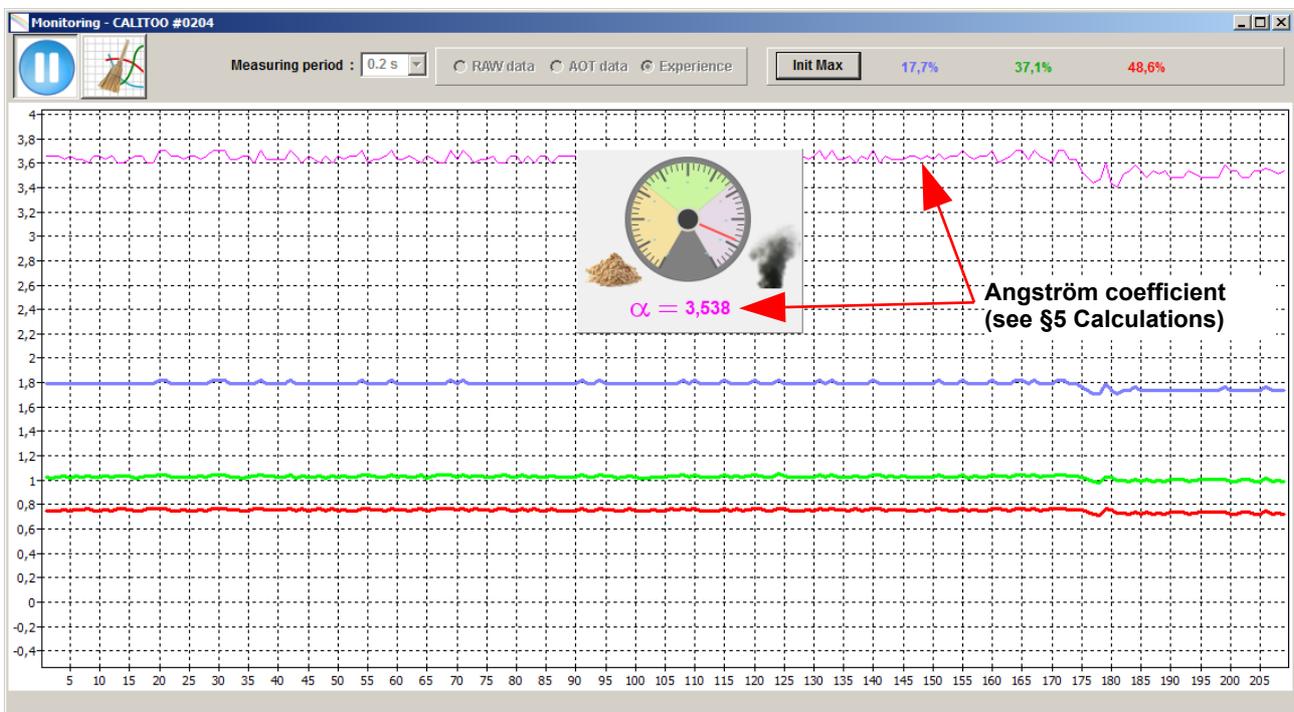
Aerosols simulation

Smoke (fine particle) is simulated with milk.

The dosing tool supplied in the kit, "Mixer" side is soaked in the milk to remove a few drops which are then placed in the water of the experiment. Mix well.



Results :

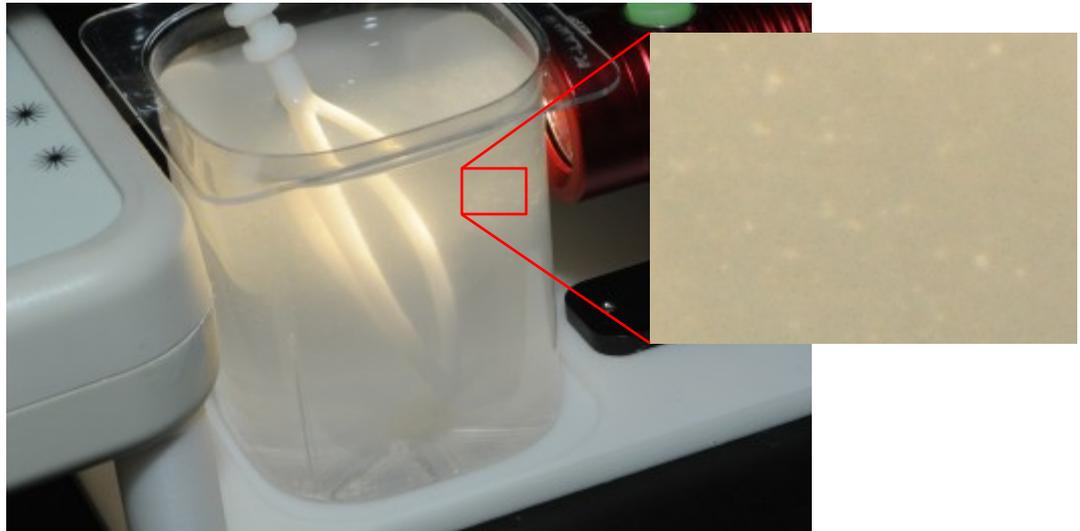


The curves of the measurements in blue, green and red are very spaced, indicating the presence of fine particles in water (the atmosphere). The Angstrom coefficient is displayed numerically with the gauge and in the form of a purple curve. It is great when the particles are fine.

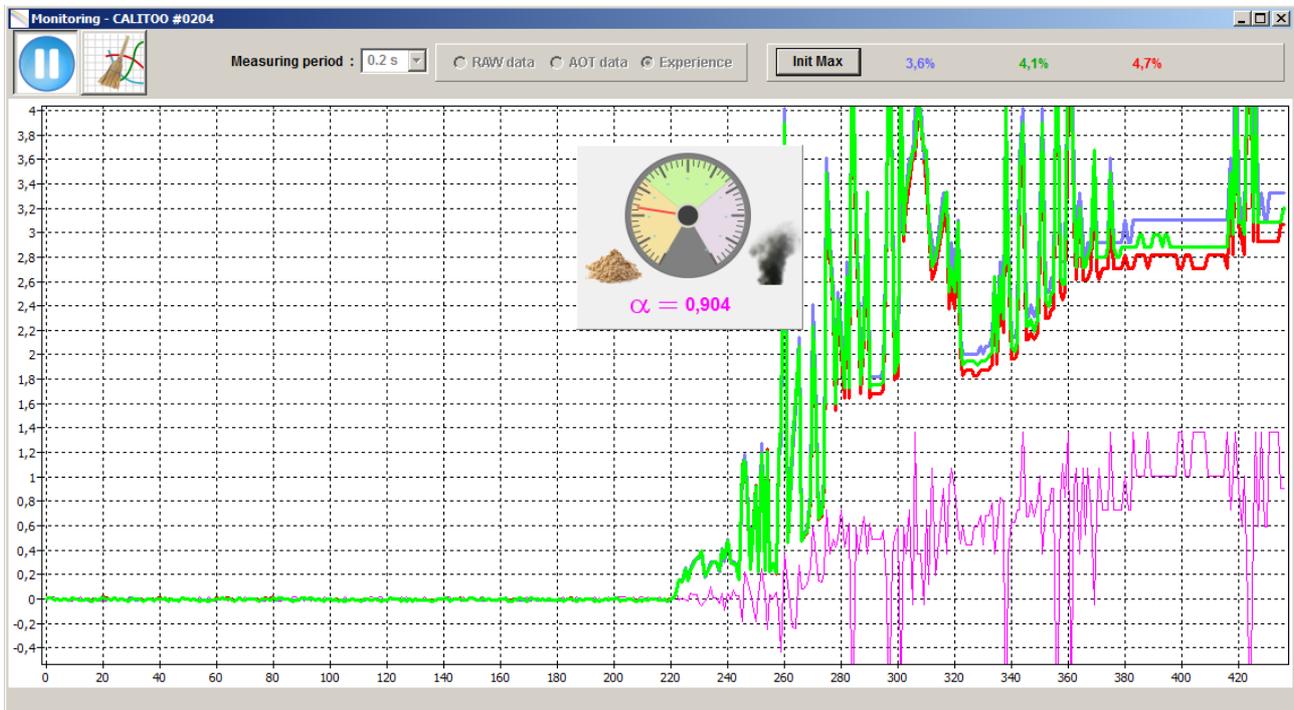
The dust (large particle) is simulated with white clay or flour.

The dosing tool is used on the shovel side to do the clay dosage to be added to the pure water.

The mixing side of the tool is then used to homogenize the clay in the water.



Results :



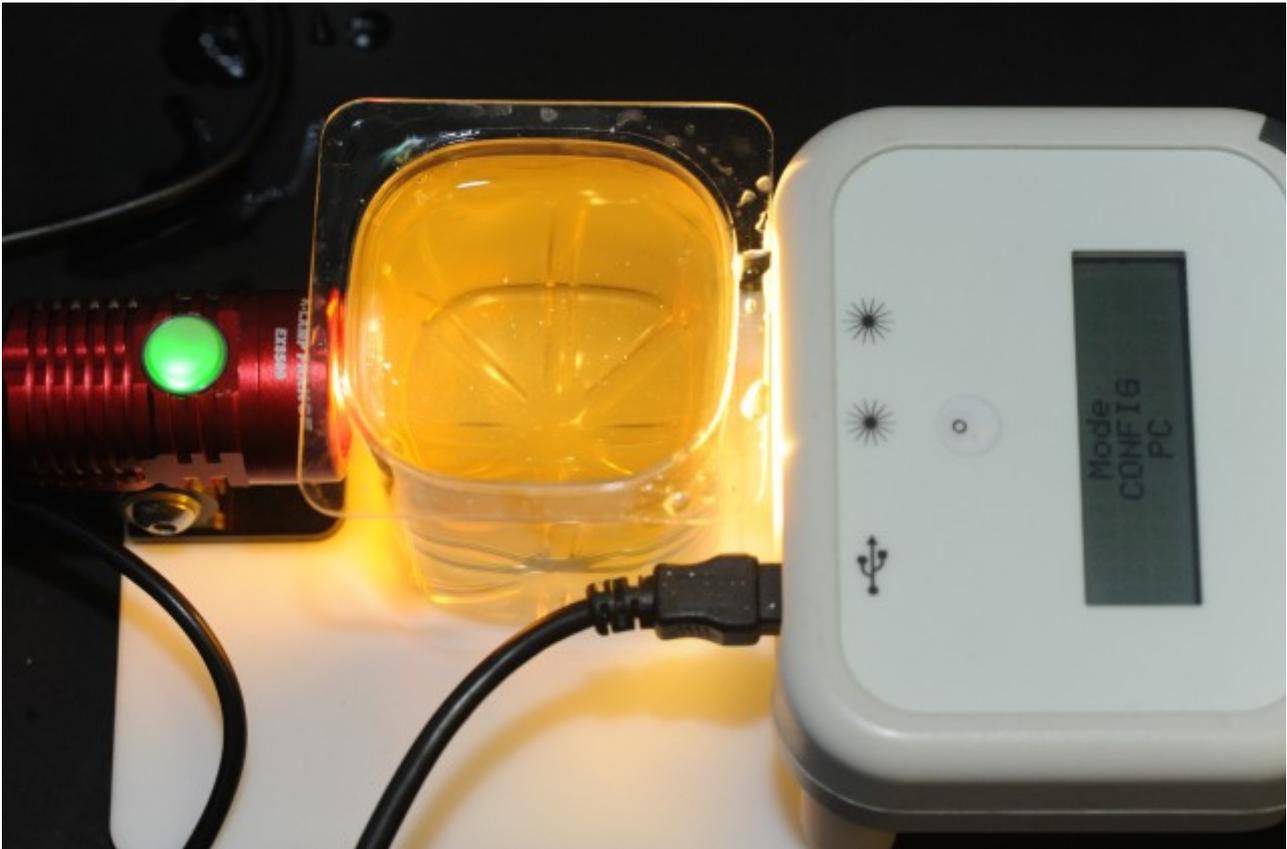
The curves of the measurements in blue, green and red are very close, indicating the presence of large particles in the water (the atmosphere). The Angstrom coefficient is small because we detect large particles.

Advice

Be careful not to put too much milk or clay in the water, because a certain amount of light must be allowed to make good measurements.

Remember to clean very well the plastic glasses between experiment sequences.

Try different dosages and different "particles" in water, such as tea, for example :



The field of experimentation is open to scientific imagination !

5. Calculation

During the calibration of reference level, maximum values are measured in blue, green and red.

Then, during measurements, following calculations are made to display different curves :

Blue curve : Blue value = $\text{Log}(\text{Max Blue}) - \text{Log}(\text{Blue measure})$

Green curve : Green value = $\text{Log}(\text{Max Green}) - \text{Log}(\text{Green measure})$

Red curve : Red value = $\text{Log}(\text{Max Red}) - \text{Log}(\text{Red measure})$

Purple curve : Alpha (Angstrom Coeff.) = $(\text{Blue value} - \text{Red value}) / \text{Log}(619 / 465)$

619 = Red wave length

465 = Blue wave length

6. Alignment

Kits were checked before shipment, but after several manipulations, it is possible that the alignment of the lamp with the optical path of the Calitoo is no longer good.

Here's how to check the alignment of the lamp and the Calitoo:

1. Connect the power supply to the lamp. The lamp button should light green.
2. Select the strongest luminous flux by pressing the lamp button several times.
3. Start the Calitoo, in Measure mode, display the maximums.

The value measured in green should be around 500 (674 in the picture below).

If the gross green reading is below 300, adjust the alignment by slightly loosening the two screws fixing the lamp under the base. The inclination of the lamp can also be adjusted by loosening the side screw.

The aim is to bring the luminous flux to the center of the sensor.



7. Sources

(1) Atmosphere Optical Laboratory : <http://www-loa.univ-lille1.fr>

(2) Calitoo web site : <http://www.calitoo.fr>

(3) EURL TENUM : <http://www.tenum.fr>

Video of experiment : <https://www.youtube.com/watch?v=MIHDgO0PDno>

Where to buy the kit : <http://www.tenumshop.com/fr/home/4-calitoo-particle-sizer.html>